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Evaluation of different China aster (*Callistephus chinensis* L. Nees) genotypes in the Terai region of West Bengal

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ABSTRACT

The experiment was laid out in Randomized Completely Block Design with three replications. Sixteen genotypes namely, Arka Poornima, Arka Archana, Arka Aadya, Arka Kamini, Arka Shashank, Phule Ganesh White, Phule Ganesh Pink, Phule Ganesh Purple, Phule Ganesh Light pink, Pink Cushion, Arabhavi Aster Collection-1 (AAC-1), Namadhari Pink, Selected line (L-76), Selected line (L-179), Selected line (L-179/1) and Selected line (L-56) have been collected from IIHR, Hessaraghata Lake, Bengaluru, Karnataka for the trial.The different morphological, phenological as well as floral traits have been collected during the crop period which showed significant variation among the evaluated China aster genotypes. The maximum number of flowers per plant was recorded in 'Arka Aadya' (71.40) and 'Arka Shashank' (66.27) statistically at par with 'Arka Aadya' and the highest vase life as cut flower was noticed in Arka Shashank (11.67 days). Flower diameter was maximum in Phule Ganesh White (8.29 cm) which was at par with Arka Poornima (6.92 cm) and Phule Ganesh Purple (6.53 cm). Among the all genotypes, the maximum weight of ten fresh flowers were observed in Arka Poornima (54.17 g) which was statistically at par with Phule Ganesh White (53.61 g). These characters are considered to be very important with respect to commercial value of the variety for fulfil the consumers demand. The genotypes Arka Poornima, Phule Ganesh White, Arka Shashank, Arka Kamini and Arka Aadya may be recommended for commercial cultivation as loose flowers as well as cut flowers in the Terai region of West Bengal.

Introduction

China aster (*Callistephus chinensis* L. Nees) belongs to the largest family of flowering plants, 'Asteraceae'. The genus *Callistephus* is derived from two Greek words 'Kalistos' and 'Stephos' meaning 'most beautiful and 'a crown' referring to the flower head respectively. It was first named by Linnaeus as *Aster chinensis* but Nees changed this name to *Callistephus chinensis* (Janakiram, 2006). The plant is medium tall, 18 inches to 24 inches in height (Emsweller *et al.,* 1937). Strube (1965) described floral biology of China aster. The flower of China aster is head or capitulum which involves outer ray florets (pistillate) and central disc florets (hermaphrodite). According to him, its flower head consists of both pistillate ray florets and perfect disc florets. It is diploid (2n) having a chromosome number 2n=18 and is native to China. In India, China aster occupied approximately more than 5000 ha

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area. It is being grown in a few states of India like Maharastra, Karnataka, Tamil Nadu, West Bengal and Andhra Pradesh (Chowdhuri *et al.*, 2016). It is widely cultivated because of its wide spectrum of attractive colours and comparatively having longer vase life (Chaitra and Patil, 2007). Among the flowering annuals, China aster ranks third after Chrysanthemum and Marigold for popularity (Sheela, 2008). It is traditionally grown for its loose flowers as well as cut flowers. Due to long vase life as well as field life, these flowers are being used for various purposes like bouquets preparation, flower arrangements, bedding plants, edge, and herbaceous borders in gardens, flower shows and exhibitions. The dwarf genotypes of China aster are being used for edges and window boxes. The present-day Asters have been developed from a single form of wild species viz. *Callistephus chinensis.* The research works and recommendation of suitable genotypes for the Northern part of West Bengal is still now in the stage of infancy. The yield of flower and quality depend on varietal characters and greatly influenced by climatic factors. The climatic factors like photoperiod, temperature, relative humidity and also soil moisture influenced both vegetative and reproductive phases of the plant which ultimately leading to variation in the performance of genotypes. Hence, plants have to be exposed to proper climatic factors in order to get optimum and economic flower yields. The selection of genotypes for quality produces as well as to fulfil the market demand is an important factor however; the literatures and recommendation of suitable genotypes in this region are not available for commercial cultivation of China aster. It is essential to recommend a set of well performing genotypes of China aster for this region because the suitable agro climatic conditions are unique in nature for China aster cultivation under open field condition during winter session in the Terai region of West Bengal.

Material and Methods

The experiment on "Studies on performance of China aster (*Callistephus chinensis* (L. Nees) Genotypes in the Terai Region of West Bengal" was carried out at the Department of Floriculture, Medicinal and Aromatic Plants, Faculty of Horticulture, Uttar Banga Krishi Vishwavidyalaya, Pundibari, Cooch Behar, West Bengal, India during the year 2019-2020 and laid out in Randomized Completely Block Design with three replications. Sixteen Genotypes viz;Arka Poornima, Arka Archana, Arka Aadya, Arka Kamini, Arka Shashank, Phule Ganesh White, Phule Ganesh Pink, Phule Ganesh Purple, Phule Ganesh Light pink, Pink Cushion, Arabhavi Aster Collection-1 (AAC-1), Namadhari Pink, Selected line-76 (L-76), Selected line -179 (L-179), Selected line-179/1 (L-179/1) and Selected line-56 (L-56)were collected from Mahatma Phule Krishi Vidyapeeth, Rahuriand Indian Institute of Horticulture Research, Bengaluru and Selected lines were collected from Kittur Rani Channamma College of Horticulture, Arabhavi, Karnatakafor the experiment.The seedlings of the genotypes have been planted at a spacing of 40cm X 40cm. The plot size was 2.00 m X 2.00 m and 25 plants were accumulated in a plot. The geographic position of the experimental site is 26.40˚N latitude and 89.38˚E longitude. The site lies in the sub-Himalayan plains with an altitude of 44m above mean sea level and falls under the Terai Agro-climatic Zone of West Bengal. At the time of land preparation 25 tonnes of well decomposed FYM per hectare and 90: 60: 60 kg NPK per hectare were applied and top dressing @ 90 kg/ha of nitrogen was applied after 40 days of transplanting (Rao *et al.*, 2012). All the intercultural operations and plant protection measures were taken whenever required. The observations recorded on various growth and flowering parameters were subjected to analysis of variance (ANOVA) using randomized block design (Gomez and Gomez 1984). and OPSTAT online statistical analysis software. The details of Pedigree and /or collection Centre of evaluated genotypes are furnished in table 1.

Results and Discussion

Significant variation in vegetative attributes like plant height (cm), plant spread (cm), leaf area at flowering stage (sq.cm) and number of branches per plant at flowering stage were recorded among the genotypes of China aster during this investigation which presented in Table 2. At the stage of one month (30 days) after transplanting, the genotype, Arka Poornima recorded maximum plant height (17.41 cm) whereas, the lowest plant height was recorded in Arka Aadya with an ordinary height of 4.23 cm.

Table 1: Details of evaluated genotypes of of China aster in the Terai region of West Bengal

S. No.	Name of the genotypes	Collection centre and brief description
1.	Arka Poornima.	AST -29 X AST-3, collected from Indian Institute of Horticulture Research, Bengaluru
2.	ArkaAadya	Selectin from population of line no. 173, collected from Indian Institute of Horticulture Research, Bengaluru
3.	Arka Archana	Selected from selfed population of line no. 15, collected from Indian Institute of Horticulture Research, Bengaluru
4.	Arka Shashank	Local Pink & AST 2 collected from Indian Institute of Horticulture Research, Bengaluru
5.	Arka Kamini	AST-6 X AST-36, collected from Indian Institute of Horticulture Research, Bengaluru
6.	Phule Ganesh Purple	Institutional released variety (AICRP ON Flori. Ganeshkhind, Pune/ M.P.K.V, Rahuri), collected from Mahatma Phule Krishi Vidyapeeth, Rahuri
7.	Phule Ganesh white	Institutional released variety (AICRP ON Flori. Ganeshkhind, Pune/ M.P.K.V, Rahuri), collected from Mahatma Phule Krishi Vidyapeeth, Rahuri
8.	Local Pink	Locally collected genotype.
9.	Phule Ganesh Light Pink	Institutional released variety (AICRP ON Flori. Ganeshkhind, Pune/ M.P.K.V, Rahuri),collected from Mahatma Phule Krishi Vidyapeeth, Rahuri
10.	Phule Ganesh Pink	Institutional released variety (AICRP ON Flori. Ganeshkhind, Pune/ M.P.K.V, Rahuri), collected from Mahatma Phule Krishi Vidyapeeth, Rahuri
11.	Selected line-56	AAC-1 X ArkaPoornima, collected from Kittur Rani Channamma College of Horticulture, Arabhavi, Karnataka
12.	Selected line-76	Arka Kamini X Phule Ganesh Purple, collected from Kittur Rani Channamma College of Horticulture, Arabhavi, Karnataka
13.	Selected line-179	AAC-1 X Arka Poornima, collected from Kittur Rani Channamma College of Horticulture, Arabhavi, Karnataka
14.	Selected line-179-1	AAC-1 X ArkaPoornima, collected from Kittur Rani Channamma College of Horticulture, Arabhavi, Karnataka
15.	AAC-1	Hybridization (Arabhavi Aster collection 1), OP Seedling selection from germplasm, collected from Kittur Rani Channamma College of Horticulture, Arabhavi, Karnataka
16.	Namdhari Pink	Collected from Namdhari Seed company, Bengaluru

The final plant height was also measured at flowering stage and the maximum plant height (89.45 cm) was recorded in genotype Phule Ganesh Purple which was significantly taller than L-179 (83.89 cm) and Phule Ganesh Pink (81.63 cm). Minimum plant height was noticed in genotype Arka Archana (33.02 cm) at flowering stage. Plant spread, at the stage of one month after transplanting, in East – West direction was maximum in genotype Phule Ganesh purple (20.93 cm) which was followed by Phule Ganesh Pink (19.25 cm), Phule Ganesh Light Pink (19.00 cm) and L-179/1 (18.67 cm). The plant spread in North – South Direction after 30 days of transplanting was minimum in genotype Arka Kamini (10.41 cm) which was at par with Arka Poornima (11.01 cm) and Arka Shashank (11.22 cm). The maximum plant Spread at the time of flowering, in East – West direction was recorded in AAC-1 (49.57 cm) which was at par with Phule Ganesh Purple (40.33 cm) and L-179 (39.83 cm), whereas the lowest was recorded in Arka Poornima18.67 cm) followed by Arka Kamini (27.73 cm) and Arka Shashank (32.11 cm). The highest plant spread in North – South direction was

recorded in cv. AAC-1 (49.23 cm) it was at par with L-76 (40.17 cm) and Phule Ganesh White (40.10 cm), whereas lowest was recorded in Arka Poornima (17.82 cm).The genotype Phule Ganesh Purple (23.07) produced a greater number of branches per plant followed by AAC-1 (22.67) and L-59 (20.28) but the least branches were noticed in genotype Arka Poornima (6.67) at flowering stage.The maximum leaf area (11.70 sq.cm) was recorded in genotype Phule Ganesh pink and the minimum were recorded in genotypes Arka Kamini and ArkaAadya (3.63 sq.cm and 5.40 sq.cm respectively).

Table no. 2. Performance of China aster genotypes for vegetative characters in the Terai Region of West Bengal

Genotypes	Plant height (cm)		Plant spread (cm)				Leaf area at flowering stage (sq.cm)	Number of branches at flowering stage
	30 DAT	At flowering stage	30 DAT		At flowering stage			
			E-W	N-S	E-W	N-S		
Arka Poornima	17.41	37.65	11.34	11.01	18.67	17.82	10.27	6.67
Arka Archana	8.40	33.02	12.96	12.97	37.30	35.24	7.00	8.87
ArkaAadya	4.23	66.48	14.68	15.37	39.63	39.21	5.40	18.60
Arka Kamini	6.99	37.71	10.95	10.41	27.73	26.47	3.63	13.67
Arka Shashank	11.40	56.51	12.66	11.22	32.11	29.57	7.57	13.87
Phule Ganesh White	12.89	65.93	14.81	13.43	36.93	40.10	6.73	9.60
Phule Ganesh Pink	11.27	81.63	19.25	19.40	33.70	29.92	11.70	14.80
Phule Ganesh Purple	9.93	89.45	20.93	19.13	40.33	36.47	10.63	23.07
Phule Ganesh Light Pink	8.04	80.25	19.00	20.13	33.30	29.87	7.40	19.27
Pink Cushion	12.51	56.76	14.35	14.57	35.04	31.39	8.47	9.53
AAC-1	7.01	69.95	13.67	15.33	49.57	49.23	10.27	22.67
Namdhari Pink	8.09	63.57	12.72	14.09	34.27	33.23	10.17	18.47
Selected line (L-76)	9.73	73.37	17.60	18.00	36.37	40.17	9.93	19.33
Selected line (L-179)	11.56	83.89	18.50	16.67	39.83	36.40	9.67	18.40
Selected line (L-179/1)	12.85	79.58	18.67	17.90	39.50	39.17	10.13	18.24
Selected line (L-56)	15.57	75.13	16.53	17.97	36.40	39.17	9.73	20.28
Mean	10.49	65.68	15.54	15.47	35.67	34.59	8.67	15.96
S. Em (±)	0.60	2.36	0.67	0.75	1.99	1.90	0.16	1.11
CD at 5%	1.74	6.81	1.94	2.16	5.75	5.48	0.47	3.20

***DAT-** Days after transplanting

Table 3 revealed that the genotype Arka Poornima recorded the least number of days to first bud initiation (39.27 days), whereas genotype AAC-1 recorded the highest number of days for first bud initiation (75.67 days). Thegenotype 'Arka Poornima' took minimum number of days (58.27 days) to first flower opening after planting which wasstatistically difference with genotype 'Pink Cushion' (61.47 days) and cv. 'Arka Shashank' (63.13 days). Whereas, genotype 'AAC-1' was late to reach first flower opening (97.67 days). The genotype Arka Poornima took minimum number of days (70.07 days) to first flower full blooming and significantly differed with genotype namely Arka Shashank (73.67 days) and Pink Cushion (74.07 days) whereas the genotype AAC-1 took maximum number of days (108.27 days) to first flower full blooming followed by genotype Phule Ganesh Purple (100.87 days).The genotype AAC-1 took maximum number of days (120.97 days) to first

flower wilting from transplanting followed by genotypes Phule Ganesh Purple (115.17 days) and Phule Ganesh Pink (109.37 days). The genotype Arka Poornima (83.07 days) took minimum number of days to first flower wilting. The genotype Arka Shashank (40.00 days) produced flower for long period. Minimum duration of flowering was observed in genotype AAC-1 (26.67 days) and L-76 (30.00 days).

Table no. 3. Performance of China aster genotypes for flowering characters in the Terai Region of West Bengal

Genotypes	Total nos. of flowers per plant	Total nos. of flowers per bed	Flower diameter (cm)	Stalk length (cm)	Wt. of 10 fresh flowers (g)	Wt. of 10 dried flowers (g)	Vase life (days)
Arka Poornima	23.87	585.67	6.92	17.09	54.17	9.57	8.33
Arka Archana	45.13	1091.67	6.44	13.87	38.87	8.45	9.67
ArkaAadya	71.40	1707.33	5.57	18.00	29.41	5.71	8.67
Arka Kamini	43.53	1025.00	6.36	14.69	32.03	8.72	7.67
Arka Shashank	66.27	1570.67	6.20	21.53	42.60	8.80	11.67
Phule Ganesh White	48.67	1175.33	8.29	25.19	53.61	9.38	9.67
Phule Ganesh Pink	42.93	1043.67	6.35	15.21	42.15	9.11	9.00
Phule Ganesh Purple	42.33	1021.67	6.53	15.07	46.47	9.29	9.00
Phule Ganesh Light pink	50.80	1240.67	5.66	15.81	41.22	8.82	9.00
Pink Cushion	46.93	1142.33	5.95	21.92	24.88	5.56	7.67
AAC-1	41.20	1010.00	5.98	25.91	45.30	8.88	7.33
Namdhari Pink	51.47	1266.00	5.99	20.99	24.24	6.68	8.00
Selected line (L-76)	48.27	1170.33	5.05	22.53	36.38	4.81	6.67
Selected line (L-179)	66.13	1517.33	5.43	22.43	38.06	5.12	8.00
Selected line (L-179/1)	60.07	1469.33	5.24	20.46	36.47	5.19	8.00
Selected line (L-56)	50.73	1116.67	4.24	23.71	39.56	5.08	7.00
Mean	49.98	1197.10	6.01	19.65	39.09	7.45	8.46
S. Em (±)	2.37	68.15	0.19	1.31	1.61	0.64	0.35
CD at 5%	6.84	196.84	0.56	3.78	4.66	1.85	1.02

Performance of China aster genotypes for flowering characters in the Terai Region of West Bengal represented in Table 4. The maximum number of flowers per plant were recorded in genotype 'ArkaAadya' (71.40) which was statistically at par with genotypeArka Shashank and genotype L-179.On the other hand, the minimum number of flowers per plant was recorded in genotypeArka Poornima (23.87). The genotypeArkaAadya was significantly better than genotypeArka Shashank (66.27), L-179 (66.13) and L-179/1 (60.70). Maximum number of flowers per bed were recorded in genotypes 'ArkaAadya' (1707.33) and 'Arka Shashank' (1570.67) which were statistically at par with the best. While least flowers per bed were noticed in genotype 'Arka Poornima' (585.67). The genotype 'AAC-1', 'Phule Ganesh Purple', 'Arka Kamini', 'Phule Ganesh Pink', and 'Arka Archana' (1010.00, 1021.67, 1025.00, 1043.67, and 1091.67 respectively.) were also better as compare to the best cv. Arka Aadya in regards to total number of flowers per plot. Flower diameter was maximum in genotypes Phule Ganesh White (8.29 cm) which was statistically at par with genotypesArka Poornima (6.92 cm) and Phule Ganesh Purple (6.53 cm). The minimum size of flower was observed in L-56 (4.24 cm) which showed significantly differed with the large size flower. The longest flower stalk was

recorded in genotype AAC-1 (25.91 cm) and it was statistically at par with genotype Phule Ganesh White (25.19 cm), genotype L-76 (22.53 cm) and genotype L-179 (20.43 cm). Whereas shortest stalk length was recorded in cv. Arka Archana (13.87 cm). Among all the genotypes, the maximum weight of ten fresh flowers was observed in genotype Arka Poornima (54.17 g) which was statistically at par with genotype Phule Ganesh White (53.61 g). While the minimum weight of ten fresh flowers were recorded in genotype Namdhari Pink (24.24 g). The maximum dry weight of ten flowers recorded in genotype Arka Poornima (9.57 g) and minimum in genotype L-76 (4.81 g). The highest vase life was noticed in genotype Arka Shashank (11.67 days). Whereas the lowest was noticed in genotype L-76 (6.67 days).

Table 4. Performance of China aster genotypes for phenological characters in the Terai Region West Bengal

Genotypes	First Flower Bud Initiation (Days)	First Flower Opening (Days)	First Flower Full Opening (Days)	First Flower Wilting (Days)	Duration of Flowering (Days)
Arka Poornima	39.27	58.27	70.07	83.07	33.67
Arka Archana	46.93	66.13	76.53	91.87	36.33
ArkaAadya	61.00	73.53	82.73	96.33	32.33
Arka Kamini	66.60	75.13	87.80	101.23	32.00
Arka Shashank	40.20	63.13	73.67	90.73	40.00
Phule Ganesh White	43.53	67.80	77.53	92.63	31.67
Phule Ganesh Pink	72.20	84.60	95.00	109.37	30.67
Phule Ganesh Purple	71.87	90.80	100.87	115.17	30.33
Phule Ganesh Light pink	64.87	78.80	89.93	104.30	30.33
Pink Cushion	42.27	61.47	74.07	87.10	32.33
AAC-1	75.67	97.67	108.27	120.97	26.67
Namdhari Pink	46.27	65.73	76.53	90.50	30.67
Selected line (L-76)	53.53	70.67	80.47	93.33	30.00
Selected line (L-179)	56.67	76.53	85.27	98.43	30.67
Selected line (L-179/1)	54.20	74.80	84.87	98.23	30.67
Selected line (L-56)	56.53	74.40	84.93	97.40	31.00
Mean	***55.73***	***73.72***	***84.28***	***98.17***	***31.83***
S. Em (±)	***0.87***	***0.89***	***0.94***	***1.09***	***0.83***
CD at 5%	***2.51***	***2.57***	***2.71***	***3.16***	***2.38***

The plant height of the evaluated genotypes showed differences significantly at initial stages (30 DAT), however the 'Phule Ganesh series' showed the maximum plant height at flowering stage. The genotype 'Phule Ganesh Purple' attained maximum plant height at the stage of peak growth period. Among the genotypes, plant spread varied significantly. The maximum plant spread was noticed in genotypes 'AAC-1', 'Phule Ganesh Purple', and 'Phule Ganesh White' at peak flowering stage. From the experiment, it may be recommended that the genotypes Phule Ganesh series namely Phule Ganesh Pink, Phule Ganesh Purple, Phule Ganesh Light Pink, AAC-1, L-76, L-179, are suitable for commercial cultivation in Terai region of West Bengal both as cut flower and loose flower. The genotypes like Arka Poornima, Arka Archana and Arka Kamini recommended for pot culture and garden display as well as loose flower production. Similar findings were also reported earlier in China

aster by Chowdhury*et al.,* (2016), Rai and Chaudhary (2016), Dilta *et al*., (2007), Munikrishnappa *et al*., (2013) and in Chrysanthemum Singh *et al.,* (2017) and Kulkarni (2003). The genotype 'Arka Poornima' comparatively took minimum number of days for first flower bud initiation, and the least number of days to first flower opening and first flower full blooming were also noticed. Maximum flower diameter was recorded in genotype 'Phule Ganesh White' and also recorded maximum flower stalk length (25.19 cm) next to the genotype 'AAC-1' (25.91 cm). The genotype 'Arka Shashank' recorded maximum duration of flowering (40.00 days), and also recorded maximum days of vase life as cut flower in vase. The genotypes also showed wide variation in their productivity i.e. number of flowers per plant. The maximum number of flowers per plant were recorded in genotype 'Arka Aadya' (71.40) and 'Arka Shashank' (66.27). The quality attributes of flowers are very important to fulfilling the consumer demand. Similar results were reported earlier by Kumar *et al*., (2016), Gaikwad *et al.,* (2002) and Martolia and Rao (2018) in China aster. The genotypes 'Arka Poornima', 'Phule Ganesh White', 'Arka Shashank', and 'ArkaAadya' may be recommended for commercial cultivation as loose flowers as well as cut flowers in the Terai region of West Bengal. The genotype 'Arka Poornima' took minimum number of days to first flower opening which was followed by genotype 'Pink Cushion' and genotype'Arka Shashank'. On the other hand, genotype AAC-1 took maximum number of days for its flower opening. The difference in flower bud initiation and flower opening by genetic traits and may be influence of solar radiation and temperature. Earlier, these kinds of results also reported by Rai and Chaudhary (2016), Chowdhuri *et al.,* (2016), Dilta *et al.,* (2007), Zosiamliana *et al*., (2011), Aditya *et al.,* (2019), Martolia and Rao (2018) in China aster. Negi *et al.,* (1988) and Dilta*et al.,* (2005) in chrysanthemum also reported the similar results. With concerned to days taken for first flower full blooming, the genotypes Arka Poornima, Arka Shashank and Pink Cushion took minimum number of days for first flower full blooming. Whereas the genotypeAAC-1 and Phule Ganesh Purple reached in late to full blooming. Similar genotypeon varietal trend also observed by Chowdhuri*et al.,* (2016) in China aster. With respect to stalk length, the significant differences were observed among genotypes in China aster. The maximum stalk length was noticed in genotype AAC-1 which was at par with genotypes Phule Ganesh White, L-76, L-179, L179/1 whereas minimum stalk length was noticed in genotype Arka Archana. The differences in stalk length among the genotypes might be attributed to the inherent genetic character associated with the genotypes. Variation in stalk length was also noticed in different genotypes of China aster by Zosiamliana *et al*., (2011) and Rai and Chaudhary (2016). Kumar and Yadav (2005) and Ambad *et al.,* (2001) also reported the genotypes of gerbera as per their quality attributes due to their inherent genetic differences. More number of flowers per plant was recorded in the genotype Arka Aadya, while the genotype Arka Poornima produced the least number of flowers per plant. Significantly maximum number of flowers per bed was produced by genotype Arka Aadya and least per bed was produced by cv. Arka Poornima. The flowers produced per plant may be directly related with the production of maximum number of leaves, more plant spread, more number of branches per plant, due to synthesis of maximum photosynthates which resulted in production of good number of flower buds on the branches. The similar results were reported in China aster by Munikrishnappa *et al*., (2013), Rai and Chaudhary (2016), Chowdhuri *et al.,* (2016), Savitha *et al*., (2016), Kumar *et al*., (2016) and Dilta *et al*., (2007). Negi *et al.,* (1988) and Singh *et al.,* (2004) also reported similar evidence in Chrysanthemum and Marigold respectively.The results of having significant and positive correlations between plant height and other characters *viz*. plant spread in East-West, plant spread in North-South, leaf area, number of branches, days to first flower full opening, days to first flower wilting, and total number of flowers per plant might indicate the strong bearings of different physiological parameters like photosynthetic efficiency, translocation efficiency and reproductive development on plant growth. These physiological parameters are actually governed by genotypes and substantially influenced by environmental factors. Similar results were recorded by Poornima et al., (2006); Harishkumar *et al.,* (2018) and Tirakannanavar *et al.,* (2015) in China aster. The results of positive and highly significant correlation

of total number of flowers per plant with plant height, plant spread in East-West, plant spread in North-South, number of branches andseed yield per plant were in agreement with earlier results reported in china aster (Harishkumar *et al.,* 2018; Tirakannanavar *et al.,* 2015; Naikwad *et al.,* 2018). Similar results were also observed by Vikas *et al.,* (2011) in dahlia.

Conclusion

It may, therefore, be assumed from the findings that the genotypes which performed better in respect of quality traits may be selected for commercial production as well as further crop improvement program. The flower size (Arka Poornima, Arka Archana, Arka Kamini, Phule Ganesh White and Phule Ganesh Purple), stalk length (Phule Ganesh Pink, AAC-1 and Selected line, L-56), production of maximum number of flowers per plant (Arka Aadya, Arka Shashank and Selected line (L-179) and remaining fresh for long time after harvesting (Arka Archana, Arka Shashank and Phule Ganesh White) are the most wanted criteria for selecting the genotypes which may be fulfilled the demand of the consumers. Considering the quality attributes have been evaluated in this study, the genotypes namely, 'Arka Poornima', 'Phule Ganesh White', 'Arka Shashank', Arka Kamini, and 'Arka Aadya' may be selected for commercial cultivation for loose flowers production as well as for cut flowers production in the Terai region of West Bengal.

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Conflict of interest

The authors declare that they have no conflicts of interest.

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